ETRAP

International Conference on Education and Training in Radiation Protection

# BOOK OF ABSTRACTS

## 7th International Conference on Education and Training in Radiation Protection ETRAP 2021

***Radiation protection training in a virtual setting -challenges and opportunities-***

**March 23-26, 2021**
**Online**

**SCK CEN-BA-150**
**SCK CEN/42280725**

## Scientific programme committee

Michèle Coeck (SCK CEN), chair
Joanne Stewart (EUTERP)
Andrea Luciani (IAEA)
Eduardo Gallego (Polytechnical University Madrid & IRPA)
Marie Claire Cantone (IRPA)
Hielke Freerk Boersma (RUG)
Daniele Giuffrida (FANR)
Jan-Willem Vahlbruch (Leibniz University)
Arjo Bunskoeke (RUG)
Barbara Godthelp (HERCA)
Sylvain Andresz (IRPA-YG)
Paul Livolsi (CEA-INSTN)
Heleen van Elsäcker-Degenaar (NVS)
Pascal Froment (BVS-ABR)
Adriaan Lammertsma (EFOMP)

## Organizing committee

Michèle Coeck, SCK CEN, Belgium
Tom Clarijs, SCK CEN, Belgium
Griet Vanderperren, SCK CEN, Belgium

## Introduction

Since 1999 the ETRAP conferences intend to bring together training providers, academics, policy makers, radiation protection experts, regulators and authorities, and end-users. It offers the opportunity for learning, discussing and networking about the latest findings and developments in education and training in radiation protection.

This 7th edition focuses on the challenges and opportunities of educating and training in a virtual context.

This conference is organized by the Belgian Nuclear Research Centre SCK CEN in cooperation with EUTERP, IRPA and IAEA.

Organized by

sck cen
Belgian Nuclear Research Centre

In cooperation with

EUTERP Training & Education in Radiation Protection

IRPA

IAEA
International Atomic Energy Agency

## Programme

The timeslots indicated in the programme are in Central European Time (CET)

| **Tuesday March 23, 2021** | | |
|---|---|---|
| 13.00 – 13.15 | Welcome by SCK CEN, EUTERP, IAEA and IRPA | Michèle Coeck, SCK CEN, Belgium<br>Joanne Stewart, EUTERP<br>Andrea Luciani, IAEA<br>Eduardo Gallego, IRPA |
| 13.15 – 13.20 | Introduction to the programme | Michèle Coeck, SCK CEN, Belgium |
| **Session 1: Training online – Chairperson: Joanne Stewart** | | |
| 13.20 – 13.30 | Introductory note: Impact of COVID-19 on radiation protection training: initial perceptions | Joanne Stewart, EUTERP |
| 13.30 – 13.45 | Comparing the effectiveness of face-to-face learning and e-learning modules in radiation protection | Lisanne Van Puyvelde, SCK CEN, Belgium |
| 13.45 – 14.00 | Lessons learned: the Paul Scherrer Institute's Training Center's transition to online-learning during the COVID-19 pandemic | Maya Keller, PSI, Switzerland |
| 14.00 – 14.15 | On-line radiation protection training at a research reactor | Sheldon Landsberger, University of Texas, USA |
| 14.15 – 14.30 | Education and training in radiation protection in a virtual setting: challenges and opportunities brought by the COVID-19 pandemic | Csilla Pesznyak, University of Budapest, Hungary |
| *14.30 – 14.45* | *Break* | |
| 14.45 – 15.15 | Online poster session | |
| | *Intermezzo* | |
| 15.30 – 16.00 | Discussion and debate session 1 | - Joanne Stewart, EUTERP<br>- Eduardo Gallego, IRPA & UPM, Spain<br>- Gaston Meskens, SCK CEN, Belgium<br>- Lucía Valentino, Sociedad Argentina de Radioprotección, Argentina<br>- Maya Keller, PSI, Switzerland |

| **Wednesday March 24, 2021** | | |
|---|---|---|
| 09.00 – 13.00 | Virtual networking moment | |
| **Session 2: New didactic methods and methodologies – Chairperson: Jan-Willem Vahlbruch** | | |
| 13.00 – 13.05 | Welcome and introduction to the session | Jan-Willem Vahlbruch, University of Hannover, Germany |
| 13.05 – 13.40 | Keynote presentation: Approaches to practical exercises in the virtual laboratory | Clemens Walther, University of Hannover, Germany |
| 13.40 – 13.55 | A virtual radionuclide laboratory | Vivien Pottgießer, University of Hannover, Germany |
| 13.55 – 14.10 | The "Train the future trainers" program, a way to include soft and technical skills in a blended learning program | Isabelle Gerardy, HE2B-ISIB, Belgium |
| 14.10 – 14.25 | A cross-checked database of resources, online demos and virtual labs for radiation protection training | Francesco d'Errico, University of Pisa, Italy |
| *14.30 – 14.45* | *Break* | |
| 14.45 – 15.15 | Online poster session | |
| | *Intermezzo* | |
| 15.30 – 16.00 | Discussion and debate session 2 | - Jan-Willem Vahlbruch, University of Hannover, Germany<br>- Paul Livolsi, CEA-INSTN, France<br>- Clemens Walther, University of Hannover, Germany<br>- Francesco d'Errico, University of Pisa, Italy<br>- Riccardo Rossa, SCK CEN, Belgium |

| **Thursday March 25, 2021** | | |
|---|---|---|
| 09.00 – 13.00 | Virtual networking moment | |
| **Session 3: Legal requirements – Chairperson: Andrea Luciani** | | |
| 13.00 – 13.05 | Welcome and introduction to the session | Andrea Luciani, IAEA |
| 13.05 – 13.25 | Keynote presentation: Education and training legal requirements: can they be met in COVID-19-times? | Barbara Godthelp, HERCA |
| 13.25 – 13.40 | Advance in digital learning at KTE: a field report | Lars Hegenbart, Kerntechnische Entsorgung Karlsruhe GmbH, Germany |
| 13.40 – 13.55 | Training in radiation protection required by legislation: approach during the COVID-19 crisis and practical implementation | An Fremout, Federal Agency for Nuclear Control, Belgium |
| | *Intermezzo* | |
| 14.10 – 14.30 | Discussion and debate session 3 | - Andrea Luciani, IAEA<br>- Barbara Godthelp, HERCA<br>- Henry Lynn, Nuclear Regulatory Commission, USA<br>- Lars Hegenbart, Kerntechnische Entsorgung Karlsruhe GmbH, Germany<br>- An Fremout, Federal Agency for Nuclear Control, Belgium |
| *14.30 – 14.45* | *Break* | |
| **Session 4: Online assessment – Chairperson: Daniele Giuffrida** | | |
| 14.45 – 14.50 | Welcome and introduction to the session | Daniele Giuffrida, FANR, UAE |
| 14.50 – 15.20 | Setting the scene: Assessing competencies and how to do that online | Wim Meerholz, University of Groningen, The Netherlands |
| | *Intermezzo* | |
| 15.30 – 16.00 | Discussion and debate session 4 | - Daniele Giuffrida, FANR, UAE<br>- Hielke-Freerk Boersma, University of Groningen, The Netherlands<br>- Alicia Streppel, University of Groningen, The Netherlands<br>- Paul Livolsi, CEA-INSTN, France |

| **Friday March 26, 2021** | | |
|---|---|---|
| **Session 5: Looking forward – Chairperson: Sylvain Andresz** | | |
| 13.00 – 13.05 | Welcome and introduction to the session | Sylvain Andresz, CEPN, France |
| 13.05 – 13.25 | Keynote presentation: How our brains learn: tips for (online) teaching | Danielle Dobbe, LRCB (Dutch Expert Centre for Screening), The Netherlands |
| 13.25 – 13.40 | Social media and young generation in radiation protection (IRPA-YGN): usages and perspectives | Sylvain Andresz, CEPN, France |
| 13.40 – 13.55 | Radiomon: isotopes, radiation and nuclear technologies in a new game for the i-Generation | Fabio Nouchy, Tractebel ENGIE, Belgium |
| | *Intermezzo* | |
| 14.10 – 14.40 | Discussion and debate session 5 | - Sylvain Andresz, CEPN, France<br>- Pascal Froment, BVS-ABR, Belgium<br>- Carmel J. Caruana, University of Malta<br>- Danielle Dobbe, LRCB (Dutch Expert Centre for Screening), The Netherlands<br>- Cinthia Papp, IRPA-YG |
| *14.40 – 14.50* | *Break* | |
| 14.50 – 15.15 | Final remarks & closure | Michèle Coeck, SCK CEN<br>Joanne Stewart, EUTERP<br>Andrea Luciani, IAEA<br>Jan-Willem Vahlbruch, University of Hannover<br>Daniele Giuffrida, FANR<br>Sylvain Andresz, CEPN<br>Marie Claire Cantone, IRPA<br>Hielke-Freerk Boersma, University of Groningen |

## Poster presentations

| **Tuesday March 23, 2021 \| online poster session 1** | |
|---|---|
| Online teaching of a basic radiation protection course for future engineers | Eduardo Gallego, Universidad Politécnica de Madrid, Spain |
| Transformation of face-to-face education into virtual: experience of Argentina | Lucía Valentino, Sociedad Argentina de Radioprotección, Argentina |
| The impact of COVID-19 pandemic restrictions in the provision of training on radiation protection and safety to Radiation Protection Officers (RPOs) | Sotiris Economides, Greek Atomic Energy Commission, Greece |
| A remote radiation protection training initiative in the UK | Sarah Hunak, CMS-I Jacobs, UK |
| Curriculum development in times of a pandemic | Tom Clarijs, SCK CEN, Belgium |
| First experience in the virtualization radiation protection training at hospital level | Carlos Prieto, Hospital Universitario de La Princesa, Spain |
| Radiation safety culture in the HERT sectors | Gwen Mott, CLEAPSS, UK |
| Development and practice of a virtual nuclear simulator in radiation protection training | Sonja Schreurs, University of Hasselt, Belgium |
| Online laboratory works for PGEC | Andrey Timoshchenko, Belarusian State University, Belarus |
| Biological dosimetry training using a web-based facility | Omar García, Centro de Protección e Higiene de las Radiaciones, Cuba |

| **Wednesday March 24, 2021 \| online poster session 2** | |
|---|---|
| An online summer school in anatomy and physiology for radiation protection and medical physics students | Carmel J. Caruana, Faculty of Health Sciences, University of Malta, Malta |
| A new attractive model for attracting physics students to radiation protection and medical physics | Carmel J. Caruana, Faculty of Health Sciences, University of Malta, Malta |
| Design and use of tools for education and training in medicine with ionizing radiations and related transport operations of radioactive material | Zayda Amador Balbona, Centre of Isotopes, Cuba |
| Detektory Dla Szkół: a pilot detector-lend project for Polish schools | Katarzyna Deja, National Centre for Nuclear Research, Poland |
| Medical physics and radiation protection skills training through undergraduate final degree thesis | Sandra Oliver, Universitat Politècnica de València, Spain |
| Information for patients and carers involved in medical exposures | Carlos Prieto, Hospital Universitario de La Princesa, Spain |
| Effectiveness of possible distant radiation protection training and compliance with the Slovenian legislation | Matjaz Koželj, Jožef Stefan Institute, Slovenia |
| Challenges due to COVID-19 restrictions in implementing the national legislative framework for the recognition of Radiation Protection Experts (RPEs) and Medical Physics Experts (MPEs) | Sotiris Economides, Greek Atomic Energy Commission, Greece |
| Teaching the teachers: a series of interactive teaching-themed workshops for healthcare and radiation protection experts (RPEs) | Danielle Dobbe, LRCB (Dutch Expert Centre for Screening), The Netherlands |
| ENEN+: attracting, developing and retaining new talents to careers in the nuclear fields | Csilla Pesznyak, Budapest University of Technology and Economics, Hungary |

# Oral presentations

## Impact of COVID-19 on radiation protection training: initial perceptions

J. Stewart

EUTERP Foundation, Petten, The Netherlands

joannestewart4@me.com

**Abstract**

In November 2020 the EUTERP Foundation hosted a meeting for its Associates at which the initial impact of the challenges presented by the COVID19 pandemic on training in radiation protection was discussed. While the challenges presented were common to all, the approach taken in response to those challenges and the resulting experience varied between both the Associate organisations and individual countries.

In some cases providers paused the delivery of planned training events, but this was not for very long and it appears that, in the main, radiation protection training has continued to delivered. No examples were provided of national Competent Authorities having instituted any relaxations in regulatory requirements for training: conversely, there were some examples of situations where deferring required training was explicitly not permitted by the Authorities.

Associates reported that various options for continuing training provision had been pursued. These included:
- Retaining face-to-face delivery (where this was already the conventional modality)
- Moving to a blend of face-to-face plus virtual delivery
- Moving all training to virtual platforms

Each option brought its own challenges but with them opportunities for transformation.
While it is too early to draw any conclusions on the impact that the situation may have had on the effectiveness of training, it became clear from the discussions that it is likely that the situation has triggered a change in thinking as to preferred methods of training delivery.

This presentation will explore the reported challenges and observations in more in detail and set the scene for a more detailed exploration of the issues raised.

## Comparing the effectiveness of face-to-face learning and e-learning modules in radiation protection

L. Van Puyvelde, T. Clarijs, N. Belmans, M. Coeck

Belgian Nuclear Research Centre, SCK CEN, Mol, Belgium

lisanne.van.puyvelde@sckcen.be

**Abstract**

At the Belgian Nuclear Research Centre (SCK CEN) about 870 employees advance the peaceful applications of ionizing radiation through research, services and education and training (E&T).

Safety is a top priority to SCK CEN. Several initiatives are taken to guarantee a safe working environment, one of them being a compulsory introductory safety training for all new employees, followed by refresher courses.
With the objective to increase the flexibility for the participants, and to optimize the teaching time of lecturers, the training format is adapted from face-to-face training to blended learning in which a significant amount of online learning is introduced. An interactive e-learning with instruction-led videos and animations was developed by the SCK CEN Academy and is offered on an internal learning management system. It concerns the modules dealing with basic knowledge and theoretical principles of radiation protection: origin and basic characteristics of ionising radiation, dosimetry, biological effects and legislation. After following the online modules, employees participate in a face-to-face session on "Dynamic risk management and safety culture at SCK CEN" where aspects related to skills development and required attitudes are treated. Those who work in the controlled areas also follow an additional session on "Radiation protection in practice".

In order to evaluate the effectiveness and perception of the original face-to-face training and the newly developed e-learning modules, and to compare both, information is gathered on two levels. Firstly, to evaluate the learning delta, the participants were requested to answer the same set of technical/scientific questions before and after the training. In the face-to-face format this was done using a traditional examination sheet. In the online module the same questions were incorporated. Only after filling out the preliminary quiz the e-learning modules can be followed in defined order. Completion of the e-learning can only be reached after filling out the end quiz.
Secondly, a questionnaire was launched to monitor and evaluate the perception of the participants on the face-to-face and e-learning formats.

This paper describes the results of the analysis of the effectiveness and feedback of the participants of face-to-face and online learning modules. This information will be used in further developments of training modules within the SCK CEN Academy.

## Lessons learned: the Paul Scherrer Institute's Training Center's transition to online learning during the COVID-19 pandemic

M. Keller, G. Schmidt

Paul Scherrer Institut, Villigen, Switzerland

maya.keller@psi.ch

**Abstract**

The COVID-19 pandemic has catapulted us into the world of online teaching. Within days of going into lockdown, courses were stopped mid-way, cancelled or rescheduled, but many were quickly re-structured to be carried out partially or fully online. The idea of bringing more of our content into the digital age is nothing new, but no one ever thought we would have to do it so quickly.

Our first objective was to gain time: we quickly analysed the course contents and regulatory requirements, and decided which courses could be easily rescheduled. As PSI is a state institution with an educational mandate for systemically important industries such as nuclear power plants and emergency response organizations, some courses were impossible to postpone. Other courses featured characteristics that made them ideal for conversion into online content. Our decision making process was based on evaluation of the following criteria:

- Available resources (teachers, rooms, digital learning specialist support, hardware, software)
- Compulsory educational mandate
- Hygiene regulations
- Target group's online-readiness
- Economic aspects (course fees, booking rates, transfer costs)
- Reusability of produced digital learning products in other courses
- Suitability of content to the digital format
- Availability, technical feasibility and transfer speed for different digital formats

During the conference, we will present the process applied to the dozens of radiation safety related courses taught at the Paul Scherrer Institute's Training Center for deciding which ones to offer completely virtually or in a blended format. We will include specific examples, as well as lessons learned through our own experiences and participant feedback. We will also detail how we were able to accommodate the significant hands-on learning requirements while maintaining appropriate safety measures.

## Online radiation protection training at a university research reactor

S. Landsberger, T. Tipping, W. Payne

Nuclear Engineering Teaching Lab, University of Texas, Austin, United States

s.landsberger@mail.utexas.edu

**Abstract**

Radiation protection at research reactors encompasses a much wider scope of training requirements than usually seen at nuclear power plants, accelerators, or other industrial settings. The reasons are multi-fold. Firstly, there is a wide difference of experience in users such as students who begin in their first year compared to visiting researchers more advanced in their careers. Research reactors can offer a wide range of experimental facilities that can produce an array of isotopes of differing beta and gamma-ray strength to be used for medical applications, nuclear forensics and industrial research, neutron and prompt gamma activation analysis, radiochemistry, neutron radiography, nuclear instrumentation development and radiation damage studies. Radiation sources include the research reactor that may produce from tens of KW to tens of MW of power, neutron sources such as Pu(Be), DD (2 MeV) and DT (14 MeV) neutron generators. The University of Texas at Austin operates a 1.1 MW research reactor that is housed at the Nuclear Engineering Teaching Lab (NETL). This reactor supports a wide range of topics as described above for undergraduate and graduate students, faculty members and visiting scientists. With the rapid turnover of students and visiting scientists it behoves the university to have on-line training with rotating quizzes to reduce costs while maintaining and documenting an on-going program. The training required of the typical NETL worker includes Hazard Communication, Laboratory Safety, Hazardous Waste Management, Radiation Safety, Portable Fire Extinguisher Basics, and Information Security Awareness with periodic refresher courses. With the advent of COVID-19 and the requirement that no students attend the NETL, on-line laboratories were *beta-tested* for the first time in the summer of 2020 for an undergraduate/graduate course in Nuclear Forensics with very good success. Videos of experimental set-ups were made and distributed with the data to be analysed by the student. These experiments included half-life measurements, shielding, counting statistics, gamma-ray self-attenuation, and fission product identification. Two of these laboratories, half-life measurements and shielding, were then given to the undergraduate/graduate course in Nuclear Environmental Protection in fall 2020. A complete overview of the on-line radiation protection training will be given.

# Education and training in radiation protection in a virtual setting: challenges and opportunities brought by the COVID-19 pandemic

C. Pesznyak[1], G.L. Pavel[2], L. Cizelj[3]

[1]Budapest University of Technology and Economics, Budapest, Hungary
[2]European Nuclear Education Network, Brussels, Belgium
[3]Jožef Stefan Institute, Ljubljana, Slovenia

csilla.pesznyak@gmail.com

**Abstract**

In recent years, we have become accustomed to providing our students with face-to-face trainings with theoretical parts and laboratory work in radiation protection. We have developed competency-based programs detailing knowledge, skills and attitude. During lectures, we actively communicate with students and participants. We monitor their reactions, facilitate their learning, try to constantly explore the shortcomings, answer questions and help them to solve the different tasks in person. Then, overnight, due to the COVID-19 pandemic, our carefully established system collapsed entirely. We were full of plans, arranged programs, but suddenly, they all seemed irrelevant and not accomplishable.

The biggest challenge was to find a solution for the situation as life could not stop, students had to be educated, and colleagues had their radiation protection licenses expired. The most well-known online services and surfaces such as Microsoft teams, Google forms, Zoom and WebEx have been already familiar to us; however, we had to master how to use them effectively in practice and become able to fully transform our education into a virtual one in just a few days. Mastering these applications has been essential; however, organising digital learning consisted of many more tasks and challenges. New phrases and concepts had to be learnt, for instance; host, co-host, stream, screen share, mute or un-mute. We had to be able to schedule and start meetings, send invitations and allow participation. We had to know how to record our presentations via Teams or Zoom, and we also prepared mp4 video files using the PowerPoint programme.

As far as several aspects are concerned, digital education has many inadequacies that makes it incomparable to personal occasions especially for the field of radiation protection. Lecturers had to get used to talking to a screen alone even if there are students behind the names. The pandemic undeniably takes its toll on social life and contacts. Students miss face-to-face lectures and personal discussions after lessons as well. Many times, it is too complicated for them to parallel take notes and turn their microphones on and off to ask questions during online lectures, thus, the number of interactions have significantly decreased. In case of radiation protection, it is extremely important to have laboratory practice and learn in practice, for example; how to use dosimeters or how to decontaminate. Although students receive great, well-compiled and vivid videos on these topics, their practical competence, understandably, cannot be guaranteed by showing them the equipment and these procedures virtually. As for calculation tasks, we have used chat walls for making them more effective.

On the other hand, this extraordinary situation has presented us with several opportunities, not only difficulties. Professors and students could attend classes from the comfort of their homes.

While sometimes instructors need to prepare even more to their virtual lessons, they could truly improve their competence in modern technology and explore the world of digital teaching with its endless possibilities. Consequently, when the COVID-19 pandemic situation is over, we will still apply these newly-obtained competences and incorporate digital learning into our personal education. Nonetheless, a blended education which proportionally utilizes the conclusions of the pandemic period while providing the students and the instructors with the opportunities of being an active participant of their learning and teaching experience can be considered a feasible long-term solution for future trainings in radiation protection.

The ENEN (the European Nuclear Education Network) Association, through the ENEN+ project co-funded by the EURATOM research and training Work Programme 2016 – 2017 – 1 (#755576) of the European Commission (H2020), provides mobility grants for learners, who would like to improve their knowledge, skills and competitiveness for career opportunities in the nuclear fields.

## Approaches to practical exercises in the virtual laboratory and online teaching

C. Walther

Leibniz University Hannover, Institute of Radioecology and Radiation Protection, Hannover, Germany

walther@irs.uni-hannover.de

**Abstract**

Practical hands-on trainings in laboratories, teaching in presence and group work are an essential part of science studies. However, the last year has shown, that there is a massive need for e-learning tools at least to be prepared for any kind of unexpected incident, although online tools cannot replace a face-to-face learning in all parts.

The first semester under corona restrictions has posed great challenges to the entire university structures and new approaches had to be taken so that teaching does not come to a complete standstill. The Institute of Radioecology and Radiation Protection (IRS) has taken on this task in a special manner and was able to set up a corona-compliant virtual practical course. Thanks to many years of cooperation in several EU projects, various online experiments were available and only a few had to be set up short-term to provide an adequate substitute for a practical course, which normally takes place in the radionuclide laboratory. With different types of online and remotely handled robotic experiments both radiochemical as well as radio analytical aspects were investigated by the students during the online lab course.

Even before it came to restrictions in lectures, the IRS placed great emphasis on keeping up with the times didactically and established new teaching methods in regular operation. This includes the so-called flipped classroom concept for lectures where the classical teaching mode is inverted. This means that the students work on the learning content at home using the material provided and then come together in a presence phase to apply what they have learned with the help of an instructor.
This keynote presentation will give an overview of the possibilities that the digital age has opened up for the teaching of science and where the limits can be reached in online courses.

# A virtual radionuclide laboratory

V. Pottgießer[1], J-W. Vahlbruch[1], P. Saalfeld[2], C. Walther[1]

[1]Leibniz University Hannover, Germany
[2]Otto von Guericke University Magdeburg, Germany

v.pottgiesser@irs.uni-hannover.de

**Abstract**

Since training and education of the competent authorities is a key requirement to ensure radiation protection, within the MEET-CINCH project, a Modular European Education and Training Concept In Nuclear and radio CHemistry1, a tailored training event for members of regulators and administrative bodies was developed. One challenge within this international project was that especially members of regulators have to deal with national laws, regulations and technical rules written in the national language and including varying requirements in different EU member states. Thus it was not possible to originate one tool covering all national laws in English, but to overcome this obstacle, an e-learning solution was developed with the advantage, that the written language and thus the application of national requirements can be exchanged and adapted with minimum effort.

The basic idea of the e-learning solution was an everyday but not trivial task in the professional life of members of the regulators, namely the assessment of an application for the license to operate a radionuclide laboratory. For this purpose a virtual radionuclide laboratory was developed. Similar to a computer game, the user can move through the laboratory, look around and check weather essential requirements are fulfilled or not. As not all properties could not or only poorly be visualized in the virtual laboratory, text fields that describe objects, as shown in Figure 1, were implemented to provide additional information. The application is programmed in a way that the texts can be easily adapted to another language and requirements.


*Figure 1: Additional information on objects in the virtual laboratory if they cannot be visualized properly.*

The prototype of the virtual laboratory was developed in German and aligned to the technical rule DIN 25425, as it was implemented in the pilot run of the tailored training event that was held in Hannover, Germany organized by the Institute of Radioecology and Radiation Protection at Leibniz University Hannover. DIN 25245 describes the requirements for an application of the license to operate a radionuclide laboratory. It defines the so-called room categories, which are based on the radionuclides, the amount of activity and the type of handling.

Before the presence-phase of the course, the participants had to calculate room categories for three different scenarios. The scenarios covered the three room categories RC1, RC 2 and RC3, for each scenario two versions were developed, one containing errors and one complying with DIN 25425 (see Figure 2). After entering the room virtually, the participants had to decide, which version of the laboratory would be eligible for a license taking into account the requirements for the calculated room category and were asked to identify further anomalies that could be criticized during a an inspection of a lab (see Figure 3).


*Figure 2: Menu to choose the version of the virtual laboratory to enter. The room categories corresponding to the scenarios are indicated.*

*Figure 3 left: Comparison of contact-free water tap recommended for RC2 and obligatory for RC3 and usual water tap. Right: A cup of coffee in the laboratory as example for an obvious error.*

The results had been presented at the presence phase of the course for members of regulators and administrative bodies on 29.08.2019 and a fruitful discussion aroused which contributed significantly to deepen the understanding of radiation protection in a radionuclide laboratory.

The participants were asked for an evaluation and more than 40 evaluation forms containing 10 questions on the previous knowledge, the training event itself and further development of the virtual lab were returned. The overall rating of the event was very positive and an overwhelming majority would like to take a similar course again. They emphasized that this way of learning is not only but also makes fun and therefore is very motivating. Additionally, the participants stated two further major advantages: first the accessibility of the virtual laboratory, while access to a real radionuclide laboratory is often limited, the virtual laboratory can be visited at any time. Second, they emphasized that such a tailored training event is a perfect possibility for new members of authorities to prepare for their first visit of a radionuclide laboratory in order to get familiar to the most important techniques, rules and the necessary equipment.

The positive feedback and the fact that the material (including the virtual lab) was used in another EU project just a few weeks after the pilot test run in Germany shows the versatility and demand for e-learning tools in education and training in radiation protection.

Therefore, the virtual laboratory will be improved and extended and second edition of the tailored training event is planned. This work is part of the follow-up project Augmented-CINCH2, which also includes an AR-app to visualize radiation fields and Hands-on Trainings in the virtual laboratory that can be carried out either as desktop application or with VR-googles and controllers.

# The "Train the future trainers" program, a way to include soft and technical skills in a blended learning program

I. Gerardy[1], S. Schreurs[2], D. Mostacci[3], L. Tinova[4], J. Rodenas[5], S. Soares[6], U. Scherer[7], S. Economides[8].

[1]HE2B-ISIB, Laboratory of Radiation Physics, Brussels, Belgium
[2]UHasselt, Faculty of Engineering, Diepenbeek, Belgium
[3]Alma Mater Studiorum- Universita di Bologna, Italy
[4]Czech Technical University, Prague Czech Republic
[5]Universitat Politecnica de Valencia, Spain
[6]Universitade de Beira Interior, Covilha, Portugal,
[7]Hochschule Mannheim, Germany
[8]Greek Atomic Energy Commission, Athens, Greece

igerardy@he2b.be

**Abstract**

During the period 2018-2020, seven European universities were involved in a two-year Erasmus+ strategic partnership to collaborate in the topic "Train the trainees - Train the future trainers in radiation protection and nuclear technology". We developed an educational approach expanding the target competences, in order to improve the blended learning process. Generic skills, such as SDGs and soft skills, are becoming of first importance for future proof nuclear engineers. Different innovative ways were explored and adopted to define a new methodological approach.

The developed blended learning activities have the value of 4 ECTS per year for each theme, i.e. 2 for pre-training activities and 2 for the training school. Three themes were selected 'Environmental radioactivity', 'Nuclear reactors and waste management' and 'Radiochemistry and medical dosimetry'. For each theme, a two years program was developed and organised by at least two partners at two different universities. Individual students were encouraged to follow the activities for both years.

Pre-training tasks using E-modules and tele teaching encourage students from different countries to collaborate in advance and to prepare the training tasks. Each face to face training week contains an important technical part but also include soft skills related workshops like communication to members of a teams, stakeholder awareness, teaching and training activities for students…in a graded approach of complexity over two years. During the second year, an important focus is put on communication skills. Therefore in each topic, real trainers activities were organised to a specific audience by trainees at the end on the training week. This specific audience could be college students, nurses or other non-specialist persons.

An overview of these training schools with special attention to the second year activities and the implemented new approach is presented. A dissemination workshop for a broader public is foreseen in spring 2021.

# A cross-checked database of resources, online demos and virtual labs for radiation protection training

F. d'Errico[1], C. Osimani[2], A. Malizia[3], S. Souza Lalic[4], T. Kokalova Wheldon[5]

[1]School of Engineering, University of Pisa, Italy
[2]EUTERP, formerly European Commission – Joint Research Centre, Ispra, Italy
[3]University of Rome Tor Vergata, Italy
[4]Federal University of Sergipe, Brazil
[5]University of Birmingham, United Kingdom

francesco.derrico@unipi.it

**Abstract**

The EUTERP Foundation has recently launched a database providing up-to-date information on education and training events, continuous professional development, employment opportunities, and service providers in radiation protection in Europe. At present, this extensive database focuses primarily on activities geared to the radiation protection profession. However, it is also meant to include information relating to academic education opportunities and activities. The authors of this presentation are a group of collaborating educators and trainers who wish to contribute to the EUTERP endeavour by searching, examining and utilizing online resources, such as demos and virtual labs for radiation protection training. These resources are looked for using both "surface" web search engines and the "deep" web search engines available at our institutions. In either case, we focus on publicly available resources at no cost to the end users, our students and trainees. The initial screening is carried out by the authors themselves, who identify and cross-check promising resources. The latter are then "road-tested" by our trainees and students, who provide feedback in terms of user-friendliness, learning curve and educational value of the resources. Indeed, one of the key aspects of this effort is collecting student evaluations that will guide the further identification and possibly the future development of similar tools. The immediate goal is addressing the urgent need for online tools that may replace the laboratory sessions and practical exercises that are normally included in our courses. However, we aim at supplementing our courses with these teaching methods also in a post-pandemic world. Therefore, these tools should not only be adequate from a didactic point of view, but also appealing to our demanding generations of media-savvy students. We wish to stress that no claim is made that the presented set of resources will be comprehensive and no attempt is made to rank the resources themselves. Rather, this is meant to be the description of an effort that is open to and in need for feedback and contributions from our community.

## Education and training legal requirements: can they be met in COVID-19-times?

B.C. Godthelp, A.M.T.I. Vermeulen

Authority for Nuclear Safety and Radiation Protection (ANVS), The Hague, The Netherlands
HERCA workgroup on Education and Training in Radiation Protection

barbara.godthelp@anvs.nl

**Abstract**

In the European basic safety standards a clear distinction has been made between the different roles and responsibilities of the radiation protection expert (RPE) and the radiation protection officer (RPO). To be able to achieve a common understanding of RPE and RPO implementation in the different Heads of the European Radiological protection Competent Authorities (HERCA) member states, the HERCA workgroup on education and training in radiation protection send out a request for country fact sheets on the topic as well as questionnaires for those countries that did not respond to the workgroups requests. This resulted in information on RPE and RPO implementation of 25 out of the 32 HERCA member states. Analysis of the preliminary results revealed that a separate RPE was implemented in 22 out of the 25 countries. Twenty out of the 25 countries that responded implemented a separate RPO, combined roles were reported in 3 out of 25 countries. Furthermore, recognition arrangements for RPE were in place in 24 out of the 25 responding member states. For RPO recognition arrangements were in place in 10 out of the 25 member states.
In the last workgroup meeting in January 2021, an inventory was made on the impact of the COVID-19 epidemic on the education and training legal requirements in the 10 participating countries. This showed that in most countries participating in the meeting, training in radiation protection was ongoing for both RPE and RPO albeit online. In some countries, difficulty was perceived with practicals and examination online due to certain legal requirements in their country. Some countries still conducted face to face examinations to be able to complete the recognition procedure, other replaced face to face by online interviews.

## Advance in digital learning at KTE: a field report

L. Hegenbart

Kerntechnische Entsorgung Karlsruhe GmbH, Eggenstein-Leopoldshafen, Germany

lars.hegenbart@kte-karlsruhe.de

**Abstract**

Kerntechnische Entsorgung Karlsruhe GmbH (KTE for short) is in charge of decommissioning closed-down nuclear facilities and is responsible for the management of nuclear wastes from the Karlsruhe site. KTE is a state-owned company.
Employees of KTE need to pass regular trainings in the areas of radiation protection, occupational safety, fire protection, and general plant safety in order to comply with rules and standards outlined in several legal acts, ordinances, and guidelines in the field of nuclear safety, radiation protection, and occupational safety.
Since 2017 already, annual training on a basic level has been performed using interactive e-learning mod-ules integrated in a Learning Management System (LMS). E-learning at KTE has been approved by the responsible authority.
Intermediate- and high-level trainings mandatory for lead workers are performed in the form of class lectures every three years. During the first wave of the Corona pandemic, KTE had to stop class lectures. Lecturers of KTE quickly acquired skills of live online training and began to test online lecturing to a small group of employees. Officers of the responsible authority then joined the online trainings and confirmed their efficiency, but made some additional requirements concerning feedback possibilities (e.g. webcam, questionnaire, …).
High-level training of general plant safety includes site inspections. These were performed in a virtual way. Again, the responsible authority confirmed that this method is suited for obtaining an overview at least. Nevertheless, employees will have to be physically present at their workplace for on-site briefing before they start work. This briefing is performed by an experienced supervisor.
For all parties involved, training is facilitated by using LMS-integrated electronic questionnaires instead of paper questionnaires to assess the learning outcome and for feedback method and an LMS-managed two-factor authentication instead of handwritten signatures. Live online trainings helped KTE to fulfil its training requirements in 2020. Thanks to their advantages, it is planned to continue their use in future.

# Training in radiation protection required by legislation: approach during the COVID-19 crisis and practical implementation

A. Fremout[1], T Clarijs[2]

[1]Federal Agency for Nuclear Control, Brussels, Belgium
[2]Belgian Nuclear Research Centre, SCK CEN, Mol, Belgium

An.Fremout@fanc.fgov.be

**Abstract**

According to international and national legislation, various professional profiles require education and training in radiation protection. In Belgium, new requirements entered into force in early 2020, implementing the latest requirements of the EURATOM EU BSS Directive. Via thorough stakeholder management all involved sectors were informed about the requirements and the timeline of the implementation. Detailed education and training requirements exist for workers exposed to ionising radiation, emergency workers, health care professionals including occupational medical doctors and medical physicists and radiation protection professionals such as the radiation protection officer and expert.

Taking into account that the healthcare sector is under enormous pressure during this crisis, the following measures were taken by the national regulator:

- The application of the regulations concerning the commissioning of certain new equipment and the staff allowed to operate it, was temporarily relaxed.
- For physicians using ionizing radiation in medicine, recognized experts in medical radiation physics and radio pharmacists whose license or recognition expires between March 13, 2020 and August 31, 2020, this license or recognition was automatically extended for 6 months. In addition, these categories of persons are exempted from the continuing education necessary for the renewal of their permit or recognition for the year 2020.

Of course, the basic principles of radiation protection continue to apply.

Also from a practical point of view, training courses in radiation protection were organised in adapted circumstances to prevent the COVID-19 virus from further spreading and to avoid unnecessary physical contact. These measures ranged from physical training with restrictions on social distancing to 100% distant learning where possible.

The current presentation will highlight the Belgian pragmatic approach of the regulator with regard to radiation protection education and training during the COVID-19 measures, as well as the experience of a national training centre organising radiation protection education and training for diverse target audience.

## Assessing competencies and how to do this online

E.W. Meerholz, A.R. Streppel

University of Groningen, The Netherlands

e.w.meerholz@rug.nl

**Abstract**

There are numerous ways to assess competencies, but how can you ensure that your assessment is of high quality? And how can competencies be assessed reliably in an online context? During this presentation we will first set the scene by discussing the importance of assessment, the distinction between formative and summative assessment, and ways of assessing on location and online. Following this, we will zoom in specifically on the assessment of competencies. We will discuss the unique characteristics and specific challenges one has to take note of when measuring competencies.

## How our brains learn: tips for (online) teaching

D. Dobbe

Dutch Expert Centre for Screening, Nijmegen, The Netherlands

d.dobbe@lrcb.nl

**Abstract**

Introduction
As experts we are sometimes inclined to approach teaching as simply presenting knowledge. However, there is a huge difference between telling (presenting knowledge) and teaching. When we teach, we aim to make the participants *learn,* but by merely 'telling' we are not guaranteed that participants will really learn what we want them to.

Learning and memory
Learning involves change, which results from practice or experience, since our memory does not work like a video recorder. Specifically, learning involves storing knowledge in our long term memory. But in order to get there, knowledge has to pass first through our working memory, and that can be a problem, because working memory is very limited. When we present knowledge, despite all of our best intentions, it is very easy to overload our participants' working memory, and hence impede their learning. This can happen by providing too much extraneous information that is not necessary for learning, but that does take up room in working memory, hindering the essential knowledge from passing through. Another way that our working memory can be overloaded is when our expertise makes us unaware that we should break down the content into small chunks. That is, give the participants just enough information to *digest* each one at a time, instead of choking them with too much complex information.
In addition, we now know that new knowledge can be stored better by connecting it to already-existing knowledge in our brain. The more the connections that are being made, and the stronger those connections are, the better participants will remember and be able to use the knowledge.

Teaching strategies
This understanding of how our brain handles new knowledge helps us identify strategies to enhance the participants' learning process. Some of these strategies, which apply equally to in-person and online learning and teaching, are:

1. Activate prior knowledge
   When we activate the prior knowledge of the participants on the topic of the course, new knowledge will be more easily connected to the already existing knowledge, making it easier for participants to remember it. An introductory quiz is a good example of how to incorporate this strategy.
2. Offer a step-by-step structured approach
   Breaking new content into small understandable chunks will make it easier to pass it through onto long term memory. Stripping content from unnecessary extraneous and intrinsic load will enhance this process. This could be achieved, e.g., by using a minimal amount of text on (PowerPoint) slides and using a new slide for each concept.
3. Use examples
   Examples make it easier for participants to understand content and store it in long term memory. Examples can be analogies, metaphors, visuals, or so-called *worked examples*.

4. Combine words and images
   Using words and images in the right combination will give the participants the opportunity to save the content in their brains both as text and as images, which means double profit. However, combining them in the 'wrong' way can impede learning. Accompanying visuals with either spoken or written text is most effective.
5. Make them think
   Learning is an active process. Participants will remember content that they have been actively involved with better. Having them generate answers to questions is a very effective strategy to increase information storage in long term memory. There are many ways to implement this activity, like having participants answer questions, or do assignments.

Conclusion

Taking into account how people learn, and using the strategies above, among others, helps us become more effective as educators, by teaching more than just telling, thus helping participants achieve the change that learning really requires.

# Social media and young generation in radiation protection (IRPA-YGN): usages and perspectives

S. Andresz[1], M. Sáez Muñoz[2,3], C. Papp[4,5], A. Sakoda[6]

[1]Nuclear Protection Evaluation Centre, Fontenay-aux-Roses, France
[2]Polytechnic University of Valencia, Spain
[3]Youth Club of the Spanish Society for Radiological Protection (J-SEPR), Spain
[4]National Atomic Energy Commission, Buenos Aires, Argentina
[5]Argentine Radiation Protection Society, Argentina
[6]Ningyo-toge Environmental Engineering Center, Japan Atomic Energy Agency, Okayama, Japan

sylvain.andresz@cepn.asso.fr

**Abstract**

The term "social media" refers to web-based applications that facilitate the creation and publication of content (that can be data, information, ideas, careers interest, etc.) and the development of on-line social network connecting the users' profiles with other users or groups[1]. Some of the most popular social media concern millions of users and billions of contents. Young adults were among the earliest social media adopters and continue to use these sites at high levels.
Most radiation protection organizations are present and active on social media notably to achieve public interaction[2] and their usage have been documented for some of them (ex. for Nuclear Regulatory Organizations[3]). However, the usage of social media by young professional in radiation protection and their networks is not formally known and has never been documented so far.
In 2020, the COVID-19 pandemic has skyrocketed the use of social media by (young) professionals, and in parallel introduced unprecedented challenges in the way of how information, education and training are delivered.
The IRPA Young Generation Network (IRPA YGN) has been established in 2017 with the objective to "promote the communication and collaboration of its Members".

However, since its establishment, the IRPA YGN (16 national YGN today) has only interacted remotely. So, the IRPA YGN would like to share its experience in networking and on the use of social media. Several national YGN are present on social media and making specific uses of it and would like to report about specific actions – with a particular focus in the field of education and training, actions addressed to the next generation and lessons learned.
A short questionnaire, addressed to the other national YGN can help to collect additional cases. This questionnaire will also be an opportunity to collect the point of view of the young generation about the impacts of the COVID-19 pandemic on the use of social media and what might be the far-reaching consequences.

Finally, all this information could be useful at IRPA level and for other organizations, for the elaboration of action plans to engage the young generation.

[1] *Social media*, Wikipedia, consulted December 2020;
[2] https://www.iaea.org/newscenter/news/use-of-social-media-to-achieve-interaction-with-the-public-on-medical-radiation-protection;
[3] *The Evolving Use of Social Media as a Communication Tool by Nuclear Regulatory Organizations*, Working Group on Public Communication (WGPC), Nuclear Energy Agency, NEA/CNRA//R(2019)5, 2 December 2019.

# Radiomon: isotopes, radiation and nuclear technologies in a new game for the i-Generation

F. Nouchy[1], F. Dandoy[1], D. Umunyurwa[1], M. Coeck[2]

[1]Tractebel Engineering, Brussels, Belgium
[2]Belgian Nuclear Research Centre, SCK CEN, Mol, Belgium

fabio.nouchy@tractebel.engie.com

**Abstract**

In several countries, nuclear science and technologies lack support from the population. While several factors lead to this behaviour, among the root causes one can point out the intrinsic characteristics of radiation, which is invisible and intangible, and the complexity of the technologies associated.
The already small population of potential STEM pupils and students are often left unaware of this field as they are not introduced properly to nuclear science and technologies or do not have means to visualize the physics. These youngsters would rather turn their attention to either more popular technologies for the same purpose, e.g. wind turbines if their interest is to combat climate change, or more sensational, e.g. rocket engineering if they are attracted by complex challenges.

The underlying goal of the project here described is to give visibility to nuclear technologies and their fundamental science. The direct objective is therefore to teach to the younger generation basic nuclear and radiation physics and to let them discover nuclear technologies in the fun environment of a videogame, without stressing the learning possibilities when distributing the product but accurately integrating them and declaring them as such. The primary target group are teenagers, for which videogames are an effective mean to reach a large population. The other reason for which videogames are chosen is their potential to visualize phenomena such as radiation decay and elements such as radionuclides in an attractive and accessible way, as they benefit from artistic freedom. At the same time the player learns-by-doing, if the game design is such that learning objectives correspond with game objectives.

This paper explains these effects more into detail, while it describes the decisional process that lead to define the current roadmap and approach. It then introduces the retained idea of an original videogame, focused on giving to the player a positive experience while collecting radioisotopes and where the learning part is regarded as only a side effect. It also describes the approaches considered to effectively assess if the wished educational objectives are reached, together with the way to assess the attractiveness level in order to reach the largest possible share of the population.

The long term vision is not limited to one videogame but rather a properly developed franchise to open up infinite possibilities of different story lines where all the different facets of nuclear science and technologies could be addressed. Our innovative approach relies on the support of experienced game developers and, most importantly, the cooperation of numerous nuclear stakeholders for this effort of creating, branding and spreading a product that would have the ambition of “giving a face” to all the radionuclides and decay particles and give visibility to nuclear technologies to benefit the whole nuclear industry, healthcare and research organisations.

# Poster presentations

## Online teaching of a basic radiation protection course for future engineers

E. Gallego, A. Lorente, S. Ibáñez-Fernández, G. García-Fernández, R. García-Baonza, G. Jiménez

Universidad Politécnica de Madrid, Spain

eduardo.gallego@upm.es

**Abstract**

Due to the COVID-19 pandemic, teaching at Universidad Politécnica de Madrid (UPM) during 2020 has been developed mainly online. Online teaching has made possible not to lose any of the contents of the curriculum that are usually taught, but it has undoubtedly had an influence on the quality of the student-teacher relationship. Students in general tend to not be very active during online classes. On the other hand, when groups are large, visual communication is largely lost. Students usually keep their cameras turned off so as not to lose bandwidth in their communications. They also turn off the microphones so as not to introduce noise interference during classes. All this implies that it is almost impossible for the teacher to check if the students are paying due attention during the lectures.
The tools mainly used have been Moodle and Microsoft Teams, together with a sufficiently large data storage in the UPM's own cloud. In Moodle, the students have been provided with the written content of some topics, the presentations of all the topics, collections of solved practical problems, practical session scripts, as well as direct links to the numerous videos of interest and the recordings of the lectures. The exercises proposed to students for personal work as part of their continuous assessment have also been managed through Moodle, as well as the distribution of announcements of general interest.

On the other hand, Microsoft Teams has served as a virtual classroom in which all the lectures have been organized and through which the students have used the direct chat with the teachers when they have had doubts or questions. Microsoft Teams has also allowed a very efficient video recording and downloading of the lectures, which is a useful resource that allowed students to review any lecture in case they have been absent or have lost any detail during the teacher's explanations.
As for the practical activities, those related to radiation dose calculation or shielding models have also been developed in Teams. However, with regard to the practical laboratory sessions, the aim was that the students did not lose their first contact with the ionizing radiation detection and measurement systems. A first practice on gaseous ionization detectors was recorded in video in the laboratory and supplemented with individual online questionnaires for the students in Moodle. A second practice was focused on radiation protection instruments and, trying to get them closer to the different types of radiation monitors, contamination monitors, monitors for identifying radioactive sources and neutron dosimeters, the students visited the laboratory in small teams, where the instructors made a live demonstration for them. Preventive measures against COVID-19 have had limitations but nonetheless it has been possible for students to see their operation and main properties. This practice also served to establish personal, albeit limited, contact. The university decided that the final evaluation tests were to be done through written exams carried out in person.

In conclusion, the need made it necessary to adapt teaching to online mode, making use of tools that have been very practical and of which several could be maintained in future courses as a useful complement to teaching in traditional mode.

## Transformation of face-to-face education into virtual: experience of Argentina

L. Valentino, N. Mohamad, C. Papp

Argentine Radiation Protection Society, Buenos Aires, Argentina

mohamadnora@gmail.com

**Abstract**

Online education opens a great number of challenges and benefits. In 2020, the Argentine Radiation Protection Society (SAR) developed successfully their traditional face-to-face courses into virtual courses.

SAR has a history of more than 50 years in education in radiation protection and has members working along the Argentine territory with different types of radiation sources. Besides, SAR keeps a close relationship with other national, regional and international professional societies. SAR rules, highlights some of its important purposes such as:

- the execution of works and the interchange of knowledge in radiation protection and related areas;
- the consolidation of radiation protection criteria associated to the use of radioactive and fissionable substances and to radiation sources facilities and;
- the consolidation and maintenance of radiation protection discipline as a professional specialization.

The above mentioned purposes are promoted by the realization of conferences, courses and other events. Through the years, SAR has achieved recognition for its courses, preparing its participants in practical applications and aligning to the current regulatory safety standards emitted by the Argentine Nuclear Regulatory Authority.

Due to the extreme measures applied to the community regards to COVID-19 pandemic, it was necessary to redirect the educational efforts from *in situ* work towards remote work. The situation pushed SAR education courses towards virtuality. This implied tackling not only with the necessity of upgrading the hardware and the software, but also with a relevant necessity for the staff engaged to achieve skills to manage with the new methodology. It represented the need to upgrade hardware and software and train in a rush to well-intentioned teachers and instructors that found submerged in a wide and unknown range of possibilities.

This paper describes some good practices achieved by the experience gained in converting the face to face lessons into virtual lessons and highlights some new inputs that the virtuality offers. It is expected to demonstrate that what initially started as a chance of discontinuity in the educative offer submitted by SAR, was converted into an opportunity to return renewed to the yearly working plan. It was necessary to adequate the educational approach and to build a new work methodology. It also arose a new concept to get more easily to more people leaving behind the some limitations. The more relevant associated to the number of participants in each course connected with the room constrain and participant's availability due to travel distance and time. Virtuality approached all of us and pushed down barriers.

It was also explored the possibility of offering parallel twin courses. This allows a higher number of total participants but considering a limited number of participants in each course. It profits the benefits of keeping attention and increasing the active participation.

To cope with the process of development the face-to-face lessons into the virtual lessons, it was necessary a dedicated initial coordination, the conversion of the existing material to the virtuality needs and the creation of some others. These new educational resources arose as fundamentals to bring participants closer. In this way, new rules were born and also netiquettes which is an adaptation of the etiquettes rules of the real world to the virtual world. It was also necessary to update working procedures and keep teachers engaged.

SAR goes on facing the current challenging global situation by sharing experiences and learnt lessons with the final purpose of sustaining and improving its educational quality.

## The impact of COVID-19 pandemic restrictions in the provision of training on radiation protection and safety to Radiation Protection Officers (RPOs)

S. Economides, P. Tritakis, A. Dalles, V. Tafili, S. Serfa, E. Carinou

Greek Atomic Energy Commission, Athens, Greece

sotiris.economides@eeae.gr

**Abstract**

This work presents the impact of the COVID-19 pandemic on the training on radiation protection and safety provided by the Greek Atomic Energy Commission (EEAE) according to its legislative responsibilities.

During the period March to November 2020, five training courses for Radiation Protection Officers (RPOs) were carried out. The courses were conducted either on-line or face to face and concerned forty nine RPOs engaged in practices with use of X-ray systems (for security and quality control purposes), and nuclear gauges (nucleonic control systems).

The development and conduct of the training activities were carried out according to the related procedures of the management system implemented by EEAE that meets the requirements of the ISO 29993:2017 standard (Learning services outside formal education - Service requirements).
The main challenges in face to face training due to the COVID – 19 restrictions concerned the maximum allowed number of participants per course, and the proper implementation of distancing and safety precautions according to national and workplace protocols. In case of on-line training, the adaptation of the training material and lecturing to the virtual environment, technical difficulties in the use of videoconferencing applications, and restrictions in the reproduction of practical training exercises in virtual environment, were among the issues addressed.

# A remote radiation protection training initiative in the UK

S. Hunak[1], P. Bryant[2], J. Thurston[3], P. Cole[4]

[1]CMS-I Jacobs, Warrington, United Kingdom
[2]EDF Energy, Bristol, United Kingdom
[3]Dorset County Hospital, Dorchester, United Kingdom
[4]University of Liverpool, United Kingdom

sarah.hunak@jacobs.com

**Abstract**

These unprecedented times of pandemic restrictions have had a significant impact on our ability to travel to and attend professional events such as annual conferences and training meetings. This in turn has meant that many of radiation protection professionals have struggled to obtain developmental training and collect Continuing Professional Development (CPD) points. This situation has been, and potentially will be, exacerbated by many organisations (particular universities and the health service) attempting to financially economise by restricting training budgets to only what is 'absolutely essential'.

In the UK, the Society for Radiological Protection (SRP) and the Association of University Radiation Protection Officers (AURPO) have been collaborating for many months to develop and deliver a programme of free on-line training webinars. This is to support the needs of our members and the profession as a whole both nationally and around the rest of the world, thereby acting to support CPD and promote international knowledge exchange.

The webinars are hosted using the MS Teams Live Events software facilities and so far have included a variety of topics provided by a number of different experts and aimed at two basic cohorts: (a) those persons requiring introductory or refresher training on a certain subject, and (b) those who wish for more advanced treatment of a specialised area. Topics have included non-ionising radiation protection, liquid scintillation counting, decommissioning, gamma spectroscopy, how to read the radiation legislation, and decay calculations. More topics are in the 'pipeline' such as proton beam therapy, risks assessments, and medical exposure legislation. Over the last six months, these webinars have proved to be very successful with a regular attendance of over 250 participants.

It is acknowledged that remote on-line training does not obviate the necessity for practical training in some circumstances (e.g. the rehearsal of contingency plans). However, experience gained from running these training webinars has highlighted that they can be a valuable method and resource that could conveniently and cost-effectively have a role to play moving forward – even after the pandemic is over. SRP and AURPO aspire to continue this programme of training webinars.
This paper will describe the reasoning behind this series of webinars and the techniques developed to deliver them.

## Curriculum development in times of a pandemic

D. Sjöberg[1], A. Johansson[1], S. Strömberg[1], T. Clarijs[2], L. Trudic[3], S. Rutjes[4] and S. Stöven[1]

[1]Umeå University, Umeå, Sweden
[2]Belgian Nuclear Research Centre, SCK CEN, Mol, Belgium
[3]International Security and Emergency Management Institute, Zilina, Slovakia
[4]National Institute for Public Health and the Environment, Bilthoven, The Netherlands

Tom.clarijs@sckcen.be

**Abstract**

The European project MELODY is developing a basic training curriculum on awareness and initial management of incidents with chemical, biological and radio-nuclear hazards (Internal Security Fund Police, grant agreement 814803). The curriculum is designed for emergency service personnel all over Europe, from dispatch officers over police, ambulance and fire & rescue personnel to general practitioners and staff working at hospital emergency rooms.

Since CBRN-training is not part of the standard training for these target groups, and limited options exist for vocational training, the envisaged curriculum is developed in a modular way. The MELODY curriculum comprises of seven modules that can be combined into courses lasting from a couple of hours to several days. With the intention of maximum flexibility and to reach as many end-users as possible, the first two modules, on CBRN terminology and basic CBRN knowledge, are designed for both, traditional classroom and individual online training. The MELODY eLearning can be used stand-alone in preparation for the more advanced MELODY modules 3-7, or as brief refresher training.

As part of the development process, the project team is testing and evaluating the curriculum together with target group representatives from several European countries. In order to collect empirical data, the team uses a variety of evaluation tools to assess the programme logic, the programme implementation and the programme effect, i.e. observer protocols, trainer interviews and pre-/post-training questionnaires to the trainees.

While the live test events of the classroom training, planned in four European countries for the period of September 2020 – March 2021, suffer from shifting restrictions due to the ongoing CoVID-19 pandemic, there was strong interest in an online evaluation of the MELODY eLearning. For the purpose of collecting feedback on the eLearning and of measuring its learning impact in a structured manner, the team transferred the pre-/post-training questionnaire to an online survey platform and built a "link sandwich" with the eLearning between the two parts of the questionnaire. Within a very short time MELODY partners recruited end-users as trainees for a virtual test event, and during one week in November these had access to the questionnaire and the eLearning. In this way, completed questionnaires from more than 100 trainees in eleven countries could be retrieved. These data and those collected during the live test events that nevertheless can take place are analysed by both, qualitative text analysis and statistical analysis. The results will be presented at the conference and will be used to further improve and harmonize the curriculum, so it suits and serves emergency services all over Europe.

For more information about MELODY, see https://melody.sckcen.be.

# First experience in the virtualization radiation protection training at hospital level

C. Prieto[1,2], P. García[1], R. Fayos-Solá[1], P. Botella[1], S. Honorato[1], D. Hernández[1], C.L. Candón[1], P. Castro[1], M. Roch[1] and R. Simón[1]

[1]Hospital Universitario de La Princesa, Madrid, Spain
[2]Universidad Complutense de Madrid, Spain

cprieto.hlpr@gmail.com

**Abstract**

Education and training in radiation protection is legislatively regulated in most of the medical applications of ionizing radiation. This is the case of the:

- training in radiation protection as part of the training program of medical specialties (organized into two different levels, basic and advanced, according to the degree of involvement of the different specialities in radiological procedures)
- continuous training (at least biennially) of professionals working in radioactive installations (radiotherapy, nuclear medicine, laboratories…)
- training of professionals (including security personnel) involved in the safety and security of high activity sealed sources
- periodical and initial training of professionals working in diagnostic imaging facilities.

Additionally, the new Directive 2013/59/EURATOM after its transposition to the Spanish regulation implies an increase and reinforcement of continuous training in radiation protection in the above-mentioned areas as well as in diagnostic imaging.
Education and training in this field is responsibility of Radiation Protection Departments of university hospitals.

The Covid-19 pandemic crisis has made it impossible to carry out the usual on-site training programme. So an attempt was made at our department to start the virtualization of those courses, in response to the new needs, but also trying to benefit from the advantages that may involve online training for both the department and the professionals' daily practice.

The aim of this study is to present a simple way to gradually virtualize the mandatory radiation protection training which has to be periodically provided to professionals somehow involved with ionizing radiations.
In order to achieve a simple useful solution, the courses were developed using Moodle 3.4, on the 'virtual knowledge platform' created by the hospital. Furthermore, courses are now in the process of accreditation, which makes them more appealing to professionals.

Additionally, when possible, some video training material has been developed, in association with other hospitals in the area, facilitating the enormous training effort that the virtualisation of this radiation protection material supposed in a short period of time.

Each course involves a final test, an also additional questions to change subject and go on with the course. In addition, a satisfaction questionnaire was prepared, and a forum of comments is opened during a certain period of time in order to resolve questions from the trainees.

Courses developed so far are: first level of RP training for interns (two levels to medical interns, another one to training nurses), Nuclear medicine staff training programme, Radiation protection of high activity sealed sources.

The main advantages found of the online education programmes are:

- Trainees can follow the course at their own pace, without unduly interfering with normal activity at the hospital.
- It is not necessary to stop normal functioning of medical departments to provide the training, since training is not subjected to predefined dates and possible need no shift changes.
- More professionals can be trained because of the flexibility of this type of training.
- The duration of the course can be longer and can be accredited more easily than a single session of an hour a year or every two years, which results in an improvement of the curricula of the trainees.
- The final test, the comments in the forum as well as the satisfaction questionnaire can help to improve the training for further editions.
- The incorporation of new professionals or the temporary contract of personnel no longer supposes a lack of training or a delay in it.
- Possibility of studying at different paces and saving the information and documentation associated with the course in an organized way.

Of course, there are also disadvantages in this kind of education, such as the lack of direct human interaction between teacher and students or the difficulty to encourage online participation of the students.

The score and comments at the satisfaction questionnaire at the end of each course is aimed to evaluate the fit between the content and the expectations of the trainees as well as a tool to improve future editions of the courses.

In conclusion, the problem posed by the covid-19 crisis for training in radiation protection (training that is to a large extent mandatory) was addressed through the virtualization of courses, which brought out the advantages of this kind of training, previously unknown and unused at our department. Training is now more comprehensive, reach more professionals and is more flexible, so presumably this kind of training will endure this crisis.

## Radiation safety culture in the HERT sectors

G. Mott[1], R. Whitcher[2], P. Cole[3]

[1]Imperial College London, United Kingdom
[2]CLEAPSS, Uxbridge, United Kingdom
[3]University of Liverpool, United Kingdom

gwen.mott@gmail.com

**Abstract**

From the analysis of the Fukushima incident came the renewed international interest in radiation safety (RS) culture. This led to IRPA's vision that embedding RS culture within an organisation is the most effective way of delivering the standards of safety and security that society expects. In the UK, the Society for Radiological Protection (SRP) and the Association of University Radiation Protection Officers (AURPO) responded by establishing a number of sectorial working groups to focus on developing RS culture in the various sectors working with ionising radiations. One sector was higher education, research and teaching (HERT).

In recognition that the safety culture of any organisation plays a critical role in both the effective delivery of service and the high standards of performance, the HERT working group first produced a report on the challenges presented by this sector. The report highlighted case studies to demonstrate good and bad practice in the sector and the practical methods to influence change (*The advantages of creating a positive radiation safety culture in the higher education and research sectors*. Coldwell *et al*, 2015). Alongside this UK-based work, an IRPA Task Group for RS Culture in HERT, headed by Professor Peter Cole, produced '*Ten points for developing a good Radiation Safety Culture in HERT sectors*' (now translated into other languages notably Spanish and Japanese for dissemination in Latin America and Japan). Noteworthy here, two of the ten points are appropriate training and effective communication.

From this setting, the HERT group carried out further research to give some better illumination on the status of the radiation safety culture within the UK HERT sectors. Evidence was gathered using an online survey. The survey comprised six topic sections and covered the use of both ionising and non-ionising radiations. The survey focused on respondents' views on behaviours and attitudes of radiation safety that reflect the current radiation safety culture in their organisation. From the analysis of the survey data, the HERT group recently produced a report (*The status of the radiation safety culture within the higher education, research and teaching sectors in the UK*. Coldwell *et al*, 2020). Though the responses indicate that there is a good safety culture in many organisations, the sector also has worrying shortfalls, particularly in communication and training. The outcomes and recommendations from the survey will be discussed in the context of organisations reviewing and developing the RP culture in their organisation.

# Development and practice of a virtual nuclear simulator in radiation protection training

S. Schreurs[1], J. Ceyssens[2], J. Camerotto[1], S. Vande Kerckhove[1], F. Di Fiore[2], W. Schroeyers[1]

[1]Faculty of Engineering, Nuclear Technology, University of Hasselt, Belgium
[2]Faculty of Sciences, Computer Sciences, University of Hasselt, Belgium

sonja.schreurs@uhasselt.be

**Abstract**

In (medical) nuclear environments engineers are operating or supervising/coaching workers during handling of strong and/or open sources in their daily practise. The ALARA principle forms the basis of their decisions, not only to evaluate the risks and consequences for their own operations but also for all others present in this environment. Therefore, training these skills is necessary but challenging. We will employ a virtual reality (VR) environment to accomplish a stepwise approach between theory and real practise.

The 'Virtual Nuclear Simulator' (ViNuS) project aims to develop a flexible VR environment for master students nuclear engineering with an initial focus on 2 radiation protection cases: (1) nuclear decommissioning, and (2) nuclear medicine. We will build scenarios on working with localised (open) sources and contaminated surfaces. Our system comprises off-the-self hardware and user-friendly software focusing on (i) the generation of scenarios, (ii) the speed and quality of rendering the virtual environment, and (iii) the interaction between users and the visual content. Through a modular approach, we foresee the translation to other practises or target groups in the future.

## Online laboratory works for PGEC

E. Awdanina, A. Bartkevich, I. Dubovskaya, M. Dezhurko, A. Timoshchenko, E. Tcherniavskaia

Belarusian State University, Faculty of Physics, Department on Nuclear Physics, Minsk, Belarus

a_timoshchenko@mail.ru

**Abstract**

Current pandemic situation has pushed the developments of training tools to fit them for on-line format with opportunity to organise the education and training process remotely under the control of an instructor with the opportunity to interfere in the studying process for corrections, to evaluate a student's knowledge and skills, to keep records of the a student's progress. One of the most difficult forms of lessons to be transferred from off-line to on-line mode is the 'laboratory work'. During such a work a student must use equipment for measurements, take readings, process measurement results for further conclusions.

In case of laboratory works on topics related to the basics of nuclear physics, radiation detection and measurements, the task is much easier than in the other brunches of physics. The universal laboratory equipment for radiation measurements that 'open doors' for its remote use had been developed at the nuclear physics department of Belarusian State University many years ago. The first attempts to organise remote training were entertained in few last years that was reported at the previous ETRAP conference in Valencia in 2017. But it was really applied for distance learning only in spring, 2020. Before enter to the course to implement one of the laboratory works a student must preliminary assume basic knowledge required for a particular topic and pass the quiz in the e-learning mode using training materials deployed at the STAR-NET LMS platform or at the faculty area Eduphys within the university LMS. After successfully implementing a quiz a student is eligible to perform the laboratory work. This work he/she implemented in the laboratory, or in distance mode switching to the laboratory network via internet. The universal laboratory equipment allows doing measurements at laboratory mock up remotely transferring the signal from the detector to a student's computer with use of appropriate software provided by the measurement equipment supplier. A student may vary detector's parameters within this software to reach appropriate conditions of measurement. Electrical signals producing by radiation detectors being transformed in the digital form presenting by a .dat file may be than processed by a student with the help of different mathematical software like MathCad, MathLab and like that. There is also opportunity to save time and web resources at the measurement stage providing students the appropriate .dat files accumulated by an instructor. The communication of instructors with students were realised via one of widely available platforms like Team Viewer, Skype, Zoom etc. It was found that in Team Viewer, for example, one instructor may follow the calculations making by 4 pairs of students as it is usually doing in off-line mode.

This approach is applicable for organisation of laboratory works anticipated by parts I and II of the IAEA PGEC syllabus in the framework of forthcoming PGEC event in January – June, 2021. Participants will have an opportunity to implement them while staying at their hotel, if it would require by epidemiological prescriptions. The technology of remote testing and keeping records using one of educational LMS platforms available for participants is described in the report.

## Biological dosimetry training using a web-based facility

O. Garcia[1], A. Rada-Tarifa[2], E. Lafuente-Alvarez[2], J.E. Gonzalez-Mesa[1], T. Mandina[1], G. Muñoz-Velastegui[3], Y.Astudillo-Silva[3], N. Monjagata [4], S. Aguilar-Coronel[4], A. Falcon de Vargas[5]

[1]Centro de Protección e Higiene de las Radiaciones. La Habana, Cuba
[2]Instituto de Genetica, Facultad de Medicina, La Paz, Bolivia
[3]Hospital "Carlos Andrade Marin", Quito, Ecuador
[4]Instituto de Investigaciones en Ciencias de la Salud, Asuncion, Paraguay
[5]Hospital Vargas de Caracas, Caracas, Venezuela

omar@cphr.edu.cu

**Abstract**

This paper describes the experience in a training exercise on biological dosimetry using a web-based training facility. The exercise was organized by the Latin American Biological Dosimetry Network (LBDNet). Four countries of the region, Bolivia, Ecuador, Paraguay and Venezuela, interested in the introduction of biological dosimetry but with limitations in obtain the necessary training material participated in the exercise conducted by the staff of qualified laboratory of Cuba. The BioDoseNet image repository (BIR) was used as biological dosimetry training tool.

The BIR is a databank of around 25,000 images of metaphase cells captured from slides prepared for dicentric assay (DCA) after different radiation exposure conditions. The DCA is the gold standard in biological dosimetry but require qualified training staff for the identification of aberrations, essentially dicentric chromosomes (DC). The classical training is conducted directly on the microscope. Early in this decade was demonstrated that is also possible the identification of DC on electronically transmitted images. Several labs with images used in different intercomparison exercises created the BIR. The BIR was established on behalf of the WHO and is hosted on the server of BfS in Germany. The BIR include the information of experienced scorers and consequently is a helpful tool for the training of new biodosimetry service laboratories.

The training was planned in three phases, introduction to dicentric scoring, dose response curve construction and a dose assessment exercise.

The phase one was organized in a workshop. Three modules of the repository were used in this phase. After introductory lecture, the participants, two per country organized as a team, analysed directly on the web site the modules. The first module is designed essentially to show different qualities of images and to provide instructions about deciding whether a metaphase spread should be analysed or rejected. The purpose was to start with some 'harmonization' of the scoring and rejection criteria. The second module of the BIR was used after. The images of this module are presented in the image repository twice. Initially, the images are presented alone and then again together with the scoring results from experienced laboratories. This allows new scorers to analyse the images unbiased and then compare their performance with the consensus opinion from expert scorers. During these exercises, a collective discussion was held on discordant images, i.e. those where the aberration analyses differed between the participants and/or with the repository. The third module of the BIR was used next. Each laboratory was requested to score the 50 images of the module and to report back to the coordinator the number of dicentrics observed and their intercellular distribution. This was the first test to evaluate the teams' performance. The outcome was analysed by the coordinator and discussed with all participants

A module of the BIR designed for dose response calibration curve elaboration was used in the second phase of the training. The module was analysed by each laboratory at home and the data were sent to the coordinator laboratory for compilation and statistical evaluation. Only two of the laboratories achieved statistically satisfactory results and this steered the program for the second workshop which considered the joint analysis of discordant images by the difference in dicentric scoring. Two teams, two country per teams, were formed. The teams' objective was to discuss those images where there was not complete agreement and to reach a consensus view. After this harmonization workshops, working at home, each laboratory generate a new data. The results of this second "harmonized" evaluation of the module were used for the fitting of a definitive dose response curve to be used for the dose assessment exercise on blind samples. The laboratories analysed the six blind samples at home and the results were evaluated by the coordinator.

The results of this exercise demonstrate the utility of the BIR as a training tool for the DCA. The training provided an opportunity for four cytogenetic laboratories in different countries, previously inexperienced in biodosimetry, and with problems in getting access to suitable national radiation sources to gain familiarity with the DCA. The criteria for cell selection/rejection and for dicentric scoring were discussed in detail on a cell-by-cell basis facilitating the learning process and contributing to consensus. The labs were able to generate data for producing a dose response curve for themselves and then using it to estimate successfully doses and irradiated fraction in blind samples similar to many intercomparison exercises performed by recognized laboratories. Some modules of the very extensive repository were fully analysed for the first time during this exercise; consequently, the results provided in the exercise may be useful for those interesting in use BIR as a training tool. The exercise also confirms the utility of web based scoring for the DCA community. Technical details can be obtained at International Journal of Radiation Biology
https://doi.org/10.1080/09553002.2019.1665211.

# An online summer school in anatomy and physiology for radiation protection and medical physics students

C.J. Caruana[1], E. Pace[2]

[1]Faculty of Health Sciences, University of Malta, Malta
[2]Medical Physics, Mater Dei Hospital, Msida, Malta

carmel.j.caruana@um.edu.mt

**Abstract**

Medical Physics at the Faculty of Health Sciences of the University of Malta offers a Bachelor's programme in Physics, Medical Physics and Radiation Protection. The entry requirements for the programme are physics and mathematics. In addition to study units in Radiation Protection and Medical Physics, the programme includes also study units in physics, mathematics, statistics, programming, anatomy, physiology, pathology and healthcare ethics among others. Students join classes with regular undergraduate physics students for the physics study units and classes with regular healthcare professional students such as physiotherapy, radiography and medical laboratory for anatomy, physiology, pathology and healthcare ethics classes. This arrangement ensures that we produce students with both a scientific and healthcare professional outlook. However, whilst healthcare professional students would have a pre-university background in biology (biology is a requirement to enter the bachelor programme of these professions) our students do not - putting them at a relative disadvantage. To resolve the issue we have set up a totally online pre-bachelor summer school in anatomy and physiology specifically dedicated to our students. The topics addressed during the summer school are as follows:

- An orientation to the human body
- Basic chemistry and biochemistry
- Cells
- Tissues
- Skin and body membranes
- The skeletal system
- The nervous system
- Blood
- The cardiovascular system
- The respiratory system
- The digestive system (including food metabolism)
- The urinary system

All lectures are presented via Zoom.

We are pleased to report that both the bachelor's programme and the summer school have been an unprecedented success. Indeed the summer school has bolstered student enrolment for the bachelor programme and we have solved in a permanent manner the seemingly perennial problem of dearth of physics graduates which was plaguing the radiation protection and medical physics professions. It has indeed been surprising with what enthusiasm physics and mathematics students have taken anatomy and physiology on board. We are also very much pleased to report that examination results in these two subjects have been totally on par with those of students from the other healthcare professions.

# A new attractive model for attracting physics students to radiation protection and medical physics

C.J. Caruana[1], E. Pace[2]

[1]Faculty of Health Sciences, University of Malta, Malta
[2]Medical Physics, Mater Dei Hospital, Msida, Malta

carmel.j.caruana@um.edu.mt

**Abstract**

In Malta the Radiation Protection and Medical Physics professions faced an acute shortage of entrants to the professions owing to the low popularity of two year masters programmes and the irregular number of physics/engineering graduates. Under such conditions of uncertainty the two professions would not only fail to grow but inevitably decline, leaving patients and hospital staff without the radiation protection and medical physics services required by EU directive 2013/59/EURATOM. A formula needed to be found to: (a) address the paradox of having to reduce the masters programme to one year at a time when the knowledge-skills-competences required for modern radiation protection and medical physics practice are expanding rapidly owing to the increasing complexity of medical device technology (b) ensure that the potential stock of entrants to the profession would be independent of erratic student numbers in other departments and faculties. It was decided that the best way forward would be to opt for an undergraduate inter-faculty programme that combined physics, medical physics and radiation protection. The resulting four year programme consists of 5 parallel strands namely physics/mathematics/statistics, radiation-protection/medical-physics, basic-medical-sciences, research and hospital placements. The first two strands are the major components. This innovative curricular experiment has been a great success. The combination of pure and applied physics, the inter-faculty nature of the programme (where students share lectures with both physics and healthcare professions students) together with the element of clinical practice have been found to be the most attractive features of the programme. The programme has provided a welcome boost for both Radiation Protection and Medical Physics.

# Design and use of tools for education and training in medicine with ionizing radiations and related transport operations of radioactive material

AB, Z. Amador Balbona[1], T.V., Antonio[2], O.R. Irayda[3]

[1]Centre of Isotopes, Radiation Protection Department, Cuba
[2]Higher Institute of Applied Technologies and Sciences, Safety Department, Cuba
[3]Centre of Information Management and Development of Energy, Information Department, Cuba

zabalbona@centis.edu.cu

**Abstract**

The education and training (E&T) on risk analysis is a basic process for the continuous improvement of quality and safety. The aim of this study is to design and use two tools for E&T on risk analysis, for the staff from medicine with ionizing radiations and related transport operations of radioactive material. The first one is an informative compendium made in html with Macromedia Dreamweaver 8 with more than 427 components like publications, User´s Manuals of SEVRRA and SECURE-MR-FMEA, a video about the last Cuban code, IAEA´s documents and process sheets for nuclear medicine practices. Documents on clinical laboratory, brachytherapy, radiosurgery, nuclear medicine, radiotherapy and radiopharmaceutical production, including risk matrix or failure modes and effects (FMEA) and a combined use of prospective and retrospective methods as incident learning system (ILS). Besides, there are other included topics as adverse effects in radionuclide therapy and quality management. As references, some documents are on external context, applicable International Standard Organization (ISO) and national regulations and from World Health Organization (WHO). The second one is an international incident database (IDB) belonging to an ILS for these practices with more than 1660 records until November 2019 and 1490 of these are matching to medicine. About 30 years of published events and near misses is covering from more than 16 countries mainly Australia (ARIR), the United States of America, United Kingdom and France. The adopted structure for IDB is similar to SAFRON. This includes a standard list of root causes and SAFRON´s severity scale adapted to practices. Obtaining Adjusted to radionuclide therapy and transport is Nyflot´s level scale for near misses belonging to radiotherapy. Previously FMEA scale from TG-100 of the American Association of Physicists in Medicine (AAPM) applied for patients, workers and public. The creation of a wide standardized list of root causes and its inclusion with before mentioned scales in an ILS within the Cuban code SECURE-MR-FMEA, allow to obtain many useful information for organizations. It is applying a holistic approach with risk matrix conversion to FMEA and their synergies with ILS. Recommendations to organizations and for national authorities derived of this study are accompanying results. The developed tools used for seven Cuban institutions could extend their application focusing in ongoing learning in improving quality and safety management, strengthening safety culture and increasing effectiveness and efficiency of making decisions as an answer of the Bon Call for action.

## Detektory Dla Szkół: a pilot detector-lending project for Polish schools

K. Deja, M. Kirejczyk**,** L. Dobrzyński, M. Marcinkowska-Sanner

National Centre for Nuclear Research, Świerk, Poland

katarzyna.deja@ncbj.gov.pl

**Abstract**

For the long time we have been aware that a serious problem of traditional school education, especially in physics, is its concentration on theory. Pupils very rarely, if at all, prepare and perform an experiment, then analyse and present its result. Even teachers perform an experiment in front of the class not that often. The main reason for this is the lack of time and scarcity of the experimental equipment at schools. This is a general problem, but it also applies to the teaching of atomic and nuclear physics in particular.

We would like to present the project entitled "Detektory dla Szkół" ("Detectors for Schools", which was developed at the Education and Training Division of the National Centre for Nuclear Research. The history and use of the NCBJ's detectors as an educational tool will be outlined.

## Medical physics and radiation protection skills training through undergraduate final degree thesis

S. Oliver, B. Juste, R. Miró, G. Verdú

Instituto de Seguridad Industrial, Radiofísica y Medioambiental, Universitat Politècnica de València, Spain

sanolgi@upvnet.upv.es

**Abstract**

The Final Degree Thesis (FDT) represents the last stage of undergraduate students training. In this phase, the students develop an autonomous activity with the support of one or more tutors that lead them during the learning process. One of the main objectives of the FDT is to train the students in several skills, going in depth in their knowledge acquired during the undergraduate program. The students from Biomedical Engineering, a 4 years undergraduate program taught in the Technical School of Industrial Engineers (ETSII) of the Universitat Politècnica de València (UPV) have the opportunity to develop a FDT in the field of the medical physics and radiation protection. At their second year, they have an introductory subject (radiotherapy and radiation protection) related with this topic. Developing their FDT in this field allow the students to increase their knowledge both in radiation treatment techniques and radiation protection in general. These techniques are currently used in the hospital setting, introducing them into the field of particle physics transport, simulations, experimental set up and dose calculations. Moreover, students can apply the knowledge acquired and their ability to solve problems in medical environments within broader contexts related to their field of study.

The methodology applied to carry out this process is to offer FDT's, which involve, in most cases, geometry modeling of different medical devices and Monte Carlo (MC) simulation for several clinical treatments, acquiring basic skills to develop simulation work in medical physics research. An example of the latest works titles are "Correction factors for dose measurements using Advanced Markus ionization chamber", "Modeling and validation of Varian TrueBeam LinAc geometry", "Filter design for Intraoperative linear accelerator device" or "Monte Carlo simulations to estimate dose in patients using Y90 treatment". All of these works train the students working with MC simulations, which are done with MCNP6 code, and allow them to use powerful computational tools to obtain accurate results that can be compared with experimental data. To ensure that this work can be developed online, the simulations are run in a cluster with all the infrastructure ready to launch the different cases. In addition, input file templates have been prepared for a general MCNP6 simulation. The students learn to modify this inputs according to the needs of their cases, changing parameters such as source energy, spectrum or geometry file among others. The Teams tool is used to answer student's doubts and track their work. However, some exceptional visits to hospitals are required to know the devices and make the necessary measurements.

Furthermore, this kind of FDT offers the opportunity of having contact with the radiation based machinery, hospital professionals and practices. The FDT are focused to show the different cases in which these tools can be used in the field of medical physics: external radiotherapy, intraoperative radiotherapy or brachytherapy. The FDT proposed, are bounded to real clinical needs, therefore it means an additional motivation when carrying out the project development. Moreover, they work with data provided by the main commercial manufacturers of therapy units, as Varian, Elekta and Sordina, and manufacturers of dosimetry measurement devices as PTW, under confidential agreements.

To validate the results obtained, students use data provided by hospitals as Hospital Universitari i Politècnic La Fe, València.

These kind of projects help the students to know how to work in multidisciplinary teams reproducing real contexts, contributing and coordinating their own knowledge with that of other branches and participants, which turn into good results in their FDT evaluation. The FDT methodology proposed, covers all of the basic, general and transversal skills required to acquire the degree. Finally, these FDTs can offer career opportunities related with medical physics as hospital radiophysics, among others.

## Information for patients and carers involved in medical exposures

P. Botella[1], P. García[1], S. Honorato[1], R. Fayos-Sola[1], C. Ramón[2], C. Prieto[1]

[1]University Hospital La Princesa, Madrid, Spain
[2]University Hospital 12 de Octubre, Madrid, Spain

cprieto.hlpr@gmail.com

**Abstract**

Introduction
Directive 2013/59/Euratom was partially transposed last year in Royal Decree 601/2019, on the justification and optimization of medical exposures. It highlights the importance of informing patients subjected to medical exposures about radiation protection aspects. The lack of information on ionizing radiation, together with the excess of not always truthful information in the media, causes excessive concern for both patients who are subject to diagnostic procedures with X-rays and nuclear medicine, and for those carers, who subject themselves to such exposure voluntarily in order to cooperate in the well-being of the patient. This indicates the need for both patients and their relatives or carers to receive appropriate and simple information and instructions, adjusted to the level of associated risk, in order to provide reassurance on the procedure and to limit, to the greatest extent possible the doses to the carers. The purpose of this study is to show some basic information on ionizing radiation and its effects which has been prepared both to patients who are subjected to diagnostic procedures with X-rays and/or radionuclides, and to those who attend them when necessary.

Methods
In accordance with article 3.10 of the referred Royal Decree, every person subject to a medical exposure should receive appropriate information on the benefits and risks associated with radiation dose resulting from exposure. The Medical physics and Radiation Protection department has designed information triptychs to implement these regulations. For this purpose, information provided to patients by national and international organizations, such as the IAEA or the SEFM, were used.
A total of three triptychs were designed for different groups of people. The first leaflet is aimed at family members and carers who voluntarily collaborate in the well-being of the patient subjected to diagnostic procedures with X-rays, as in accordance with Article 7 of the mentioned decree it is necessary for these people to receive basic information on the effects of ionizing radiation.
The second leaflet is aimed at patients who are to undergo a diagnostic Nuclear Medicine procedure, in accordance with article 3.10 of royal decree, which states that all persons subjected to a medical exposure, prior to the study, shall receive adequate information on the benefits and risks associated with the radiation dose caused by the exposure. The third triptych is aimed at patients with hyperthyroidism disease who undergo a metabolic treatment with I-131, including restrictions that patients have to follow in order to protect people surrounding the patient. A QR code has been included in each leaflet, which leads to an opinion survey to analyze the effectiveness of the leaflets.
The hospital's website was updated, adding a section of radiation protection, which includes frequently asked questions aimed at both patients, carers and staff, as well as the possibility of downloading the previously mentioned leaflets. This way, patients and carers but also professionals have a proper access to the information during this COVID crisis, which has made it impossible to distribute leaflets in a paper format at the hospital.

Results

The most relevant aspects of the information needed by patients and carers in diagnostic procedures have been studied and triptychs have been created to answer possible concerns about these procedures. This information has been presented as questions that could be asked by the interested persons, with images and a simple and direct vocabulary to easily capture the attention, and therefore to reach more public. According to the surveys in both diagnostic leaflets (X-ray procedures and Nuclear Medicine), the main concern for patients and carers are the possible side effects of radiation. Metabolic treatment's leaflet survey shows that the restriction which is most difficult to follow is to keep distance from their own children as answered by approximately 40% of patients undergoing hyperthyroidism treatment. Another restriction which is hard to follow is to be absent from work, as claimed by 20% of the patients. 100% of the respondents agreed that these leaflets were useful in resolving their doubts and concerns.

Conclusion

It is essential that both patients and carers who are subjected to medical exposures receive clear and simple information to ensure radiological protection inside and outside hospital facilities. This information must be accessible and easy to understand, so feedback from the patients is promoted and analyzed.

## Effectiveness of possible distant radiation protection training and compliance with the Slovenian legislation

M. Koželj, V. Slapar Borišek

Jožef Stefan Institute, Ljubljana, Slovenia

matjaz.kozelj@ijs.si

**Abstract**

COVID-19 pandemic has influenced different aspects of our life, work and education, as well as various occupational training activities. While certain forms of work could be successfully implemented from "home office", other forms either require particular tools or equipment or are a part of some chained operations and could not be successfully extracted from the production process. As far as education is considered, we have seen that transformation to distant forms of learning is possible using the existing informational infrastructure. Since this transformation has happened practically overnight and teachers and students were unprepared, we can hardly say that everything went on without problems and mistakes. The most important criterion was that the education process is taking place, and problems should be solved "on the way". The most important problems to be addressed are practical exercises, evaluation and grading.

Training in general and especially different forms of occupational training are usually a mixture of lectures, demonstrations and practical exercises. Duration is normally limited (hours, days, weeks) since objectives are precisely defined. This requires more practical involvement from training participants and focused evaluation which is formally required for final certification. Considering the purpose of occupational training, it is not possible simply to readjust (or transform) the process, criteria and evaluation due to some other requirements. This is the reason why many training events were postponed or cancelled and not simply transferred to the internet.

According to current Slovenian legislation, radiation protection training should be implemented in the form of courses, which consist of lectures and practical demonstrations and exercises. Institutions, which organize training and the course programs are approved and lecturers should be authorised radiation protection experts. A written examination is required and passing criteria prescribed. Considering all these requirements, it seems that it is not possible to implement some modern forms of distant training and examination. But this has already been done in some other countries where the training of certain categories of workers is implemented in the form of web courses, and examination is also performed through "electronic forms".

Therefore, we would like to analyse and compare the requirements of some training programs and identify categories and program segments that could be transferred to distant forms of training. This could, hopefully, not only help in avoiding the problems of pandemic times, but also improve the effectiveness of training. We would also like to propose some changes to legislation to enable implementation of this modernized radiation protection training.

## Challenges due to COVID-19 restrictions in implementing the national legislative framework for the recognition of Radiation Protection Experts (RPEs) and Medical Physics Experts (MPEs)

S. Economides, K. Karfopoulos, A. Dalles, E. Carinou

Greek Atomic Energy Commission, Athens, Greece

sotiris.economides@eeae.gr

**Abstract**

Greek Atomic Energy Commission (EEAE), as the competent authority in aspects related to radiation protection, nuclear safety and security, had the main responsibility for the transposition of the Council Directive 2013/59/Euratom in the national legislation. This transposition was performed through the Presidential Decree 101/2018 which, *inter alia*, defines in detail the role and responsibilities of RPEs, MPEs.

The RPEs and MPEs recognition framework includes two additional legal documents; the Ministerial Decision 45872/2019 in which the respective qualifications, competence and training requirements are defined as well as the EEAE Decision 4a/261 (2460/B/21.06.2019) that describes the recognition mechanism itself.

By applying the above-mentioned framework, so far, 51 RPEs have been recognized (33 for medical and 18 for non-medical applications of ionising radiations respectively), while recognition has been granted to 34 MPEs.

This work presents the mechanism and related requirements for the recognition of RPEs and MPEs, and the challenges encountered in the implementation of the associated legislative framework due to the COVID-19 restrictions. Moreover, it demonstrates the results of an analysis, based on data from the national radiation database kept by EEAE, which concerns the implemented practices and the related needs at national level.

## Teaching the teachers: a series of interactive teaching-themed workshops for healthcare and Radiation Protection Experts (RPEs)

D. Dobbe

Dutch Expert Centre for Screening, Nijmegen, The Netherlands

d.dobbe@lrcb.nl

**Abstract**

Background
The Dutch Expert Centre for Screening aims to improve breast cancer screening programs. Carrying out training programs that are effective in transferring the necessary knowledge and skills, including radiation protection of the use of X-rays, to screening personnel is crucial to achieve this goal. The healthcare experts of the Centre have extensive knowledge in their field of expertise, but they lack formal training on teaching skills and educational concepts, as is the case in many other knowledge centres. Training the trainers on these concepts holds the promise of improving their performance.

Summary of work
*Teaching Studios* were introduced to offer the (radiation) experts knowledge on educational concepts and teaching skills. These are two- to three-hour-long workshops, each one on a relevant theme, often requested by the participants. Examples of themes that have been covered are: *How to handle difficult groups*, *Presenting*, and *Teaching online*. In a highly interactive and safe learning environment, the participants are stimulated to reflect on their own experiences on teaching and learning. To demonstrate the practical effects of incorporating the previously taught concepts into their teaching responsibilities, a Teaching Studio has been devoted to redesigning one of the current courses, applying the different concepts taught in previous Teaching Studios. To gauge the effectiveness of the Studios, feedback from the participants and anonymous feedback surveys from attendees of the newly-designed courses were obtained.

Summary of results
Since the introduction of the Teaching Studios three years ago, 16 courses were redesigned. Feedback from the participants showed that they have become more aware of teaching skills as an important factor in their educational responsibilities. As a secondary positive outcome, the Studio participants have become more interested in gaining knowledge on educational concepts and innovative teaching methods. Qualitative surveys from the attendees to the redesigned courses showed that they highly appreciate the redesigned parts of the courses.

Discussion and conclusions
The Studio participants have gained more confidence in their approach to teaching, changing from content-centred to learning-based, during both designing and executing courses.

Take-home messages
Teaching Studios, aimed at providing knowledge of educational concepts and teaching skills, improve the quality of courses designed and taught by experts with teaching responsibilities who have no formal teaching training.

# ENEN+: attracting, developing and retaining new talents to careers in the nuclear fields

C. Pesznyak[1], B. Bazargan-Sabet[2], A. Abdelouas[3], F. Tuomisto[4], M. Coeck[5], G.L. Pavel[6], L. Cizelj[7]

[1]Budapest University of Technology and Economics, Budapest, Hungary
[2] University of Lorraine, Nancy, France
[3]IMT Atlantique, Nantes, France
[4]University of Helsinki, Finland
[5]Belgian Nuclear Research Centre, SCK CEN, Mol, Belgium
[6]European Nuclear Education Network, Brussels, Belgium
[7]Jožef Stefan Institute, Ljubljana, Slovenia

csilla.pesznyak@gmail.com

**Abstract**

The ENEN+ project aims at reviving the interest of young generations in the nuclear sector. Accordingly, its main objectives are to attract new talents to careers in nuclear and to develop them beyond academic curricula. It is also crucial to increase the retention of the attracted talents in nuclear careers and to involve the nuclear stakeholders within the EU and beyond. Another purpose is to sustain the interest of young generations for nuclear professions in order to make sure that the project successfully contributes to the revival of interest in nuclear disciplines. The most important nuclear fields of the project are nuclear reactor engineering and safety, waste management and geological disposal and radiation protection and medical applications.

Several different events have already been organised within the frames of the ENEN+ project. The Nuclear Competition for Secondary School Pupils helps to inform young, secondary school pupils about the nuclear sector and the BSc Summer Schools are specifically organised for undergraduate students. More than 70 BSc students applied for the first ENEN BSc Summer School and 45 BSc students participated from ten European countries in 2019 (Italy, Spain, Lithuania, Malta, Poland, Ukraine, Serbia, Russia, Romania and Hungary). During the Summer School, various programmes provided the students with the opportunity to obtain practical information while attending a memorable social event. Interesting lectures were given on all the nuclear fields and each nuclear profession was introduced in detail. The students could visit nuclear facilities, for example; research centres, nuclear power plants and medical facilities. Practical activities were performed in nuclear labs and training centres as well.

Another yearly event is the ENEN PhD Event & Prize, which supports young researchers and scientists, who can present their research work and compete in a professional environment. Up to 12 PhD presentations are nominated by ENEN Members and selected by the ENEN PhD Prize Jury. The ENEN Association supports travel expenses as well as registration fee of the conference for the finalists; however, this year the competition was held online, in the framework of the NESTet 2020 Virtual Conference, in Brussels, Belgium. For the 3 ENEN PhD prizes, ENEN Association grants 1000€ to the winners in order to cover the expenses of attending an international conference and presenting the result of their research work.
The possibility to organise the Competition for Secondary School Pupils, the ENEN BSc Summer School and the PhD Event& Prize action during the summer of 2021 will depend on the evolution of the COVID-19 pandemic.

The ENEN+ project focuses on supporting students interested in nuclear reactor engineering and safety, waste management and geological disposal, radiation protection and medical applications. The integration of further nuclear disciplines and sustainability of the ENEN+ accomplishments beyond the project life will be given due attention. Career guidance with mobility support exceeding 1.000.000 EUR is envisioned. This project is a contribution of the ENEN Association, supported by the European Commission, to the common strategic objective of all nuclear stakeholders: to preserve, maintain and further develop the valuable nuclear knowledge for present and future generations.

The ENEN (the European Nuclear Education Network) Association, through the ENEN+ project co-funded by the EURATOM research and training Work Programme 2016 – 2017 – 1 (#755576) of the European Commission (H2020), provides mobility grants for learners, who would like to improve their knowledge, skills and competitiveness for career opportunities in the nuclear fields.

Version 2.0 dated March 18, 2021